Hardie-Tynes Manufacturing Company,
Birmingham Industrial District
800 Twenty-eighth Street North
Birmingham
Jefferson County
Alabama

HAER No. AL-13

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37-BIRM,
33-

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HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD

HARDIE-TYNES MANUFACTURING COMPANY

HAER No. AL-13

Location: 800 North 28th Street, Birmingham, Jefferson County, Alabama 35203 UTM: Center 16.51864.3709630

Date: 1902; 1924

Present Owner: Hardie-Tynes Manufacturing Company

Present Use: Manufacture of heavy industrial machinery, dam equipment, naval ordnance.

Significance: The Hardie-Tynes Manufacturing Company is an example of a typical foundry and machine shop serving industrial customers in the late nineteenth and twentieth centuries The company retains substantial original equipment, including two unused cupolas dating from 1901 and 1918. Originally a vital link in Birmingham's integrated iron industry, Hardie-Tynes expanded beyond its southern mining context to produce specialized components for large public works projects such as the Panama Canal, Wilson and Hoover Dams, and the U.S. Navy.

Project Information: This recording project is part of the Historic American Engineering Record (HAER), a long range program to document the engineering, industrial and transportation heritage of the United States. The Birmingham District Recording Project was cosponsored during the summer of 1992 by HAER and by the Birmingham Historical Society, Marjorie L. White, Director.

Historian: Tanya English

Introduction

Hardie-Tynes is a mid-sized foundry producing labor-intensive, specialized products with early 20th century equipment. Much original equipment remains, including its 1902 plant, its 1925 machine shop, two cupolas in their original 1901 and 1918 state, cranes, core ovens, the pattern shop, pattern stores, the smith shop, the boiler house and air compressor. Hardie-Tynes reflects the integrated nature of production in the Birmingham District. One of many foundries established around the turn-of-the-century, it utilized locally produced pig iron, coal and coke, lumber and fluxing stone and sold many of its products to local consumers. Hardie-Tynes mine hoists, for example, serviced mines that fed the iron furnaces that made the pig iron that foundries like Hardie-Tynes used for product manufacture.

Birmingham had the greatest concentration of foundries in Alabama, and became the leading supplier of cast-iron pipe in the United States. By 1900, Alabama had surpassed Pennsylvania to become the country's major producer of foundry iron.[1] The 1925 Census of Manufactures recorded fifty-five foundries and machine shops at work in Alabama (compared to seventeen in Mississippi, thirty-seven in Florida, sixty-six in Georgia and sixty-eight in Tennessee).

The Birmingham district's vast reserves of coal, limestone, sand and iron ore--all essential to the production of iron--attracted to the region entrepreneurs such as James Sloss, Daniel Pratt, T. T. Hillman, and Henry DeBardeleben. These readily available resources facilitated the development of vertically integrated systems that were key to Birmingham's success as an iron manufacturing center. Within these straight-line systems, ironmakers obtained raw materials from their own mines and quarries, free from the controls and market fluctuation of outside suppliers, and often transported them to processing plants on their own rail systems.

In the late 19th century, the new technology of the steel-jacketed blast furnace revolutionized the iron and steel industry and the Birmingham region. The first blast furnace in the Birmingham district, that of the Pratt Coal and Coke Company (later Tennessee Coal & Iron-TCI), went into operation in November of 1880, followed by the Sloss City Furnaces in 1882 and 1883, and Woodward Iron Company furnaces in 1883. By the 1890s this former agriculture area had become an industrial center, with a population of nearly 20,000.

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[1]David W. Lewis, Sloss Furnace (Tuscaloosa and London, University of Alabama Press, 1994).

The unique metallurgical qualities of the Birmingham district's Red Mountain iron ore (high phosphorus and silica content) were well suited to the production of foundry iron. In its molten state, the iron flows readily into foundry molds, and when cool it is easily cut, shaped or finished by machine. These "raw material constraints, "as Dr. Jack Bergstresser has called them, profoundly shaped the technology of Birmingham's iron industry. Foundry iron was best smelted in mid-sized furnaces rather than the larger furnaces standard in steel production. Through trial-and-error, Birmingham's industrialists developed a furnace with the exact specifications necessary to produce high quality foundry iron. Birmingham eventually developed the national standard for American foundry iron.

The combined effect of abundant and readily available raw materials and specially designed blast furnaces enabled the Birmingham district to produce the cheapest foundry iron in the country. By the turn-of-the-century, Alabama made over one quarter of the nation's foundry iron,[2] and Birmingham was the nations largest producer of foundry iron, surpassing even Pittsburgh. As a result, rolling mills, iron pipe and specialized foundries concentrated in the Birmingham district. Today, Hardie-Tynes is one of the few extant foundries and machine shops that once played a significant role in the Birmingham industrial district.

When Hardie-Tynes' parent company, the Birmingham Iron Works, opened in 1883, it was among the city's earliest machine shops and foundries. The Birmingham directory for 1883-84 lists four such firms: the Birmingham Iron Works, Linn Iron Works, Jefferson Foundry and HT Beggs and Son. Contemporary sources valued the Birmingham Iron Works at $50,000, in 1886, making it easily the largest of the seven foundries considered.[3] The company originally made steam pumps, steam engines and cast iron pipe. By the 1890s it concentrated on machines alone.

Hardie-Tynes origins lie in the 19th century pioneering ventures of its parent company, Birmingham Iron Works and, like its parent company, specialized in heavy industrial machinery; especially important was its production of Corliss and slide valve steam engines. Hardie-Tynes was an integral part of Birmingham's large complex of foundries. The manufacturing census for 1923 revels ninety foundry and machine shops in the entire state. The Bessemer Foundry and Machine Co. also made mine machines, and the Birmingham Machine & Foundry Company advertised heavy machines,

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[2]Lewis, Sloss Furnace.

[3]Birmingham City Directory, 1902

including Corliss engines. Hardie-Tynes was clearly among the most important manufacturers of steam engines (especially Corliss engines), mine hoists and (later) air compressors in Birmingham; its primary competitors were located in other cities outside Alabama. Compared with other firms in the region, Hardie-Tynes was an "extensive" boasting the largest plant in the South, in 1913.[4] At its peak, it produced over forty Corliss engines a year.

Hardie-Tynes differed from most Birmingham foundries. In the twentieth century, technological innovations in the foundry and machine industry generally addressed issues of mass-production and mechanization--how to efficiently produce large orders of stoves or wheels, or how to handle large quantities of raw materials. Hardie-Tynes, on the other hand, produced machines specially adapted to each purchaser's requirements, making at most one Corliss steam engine a week. Speed was of less importance to Hardie-Tynes than foundry skill and reliable sources of orders. As Foundry commented in 1900; "Every foundry uses sand and metal to make castings, but what a difference in the manipulation of materials!"[5] Similarly, the machine shop layouts and conveyor belt systems of the car factory, created to lower unit costs of production, had little relevance to the Hardie-Tynes' model. At Hardie-Tynes, the rough casting was taken back and forth across the shop to suit its particular machining requirements.

By retaining its focus on large, complex castings and machinery, Hardie-Tynes took advantage of the growing market for specialized manufacturing of air compressors and the development of new product lines in dams and naval supplies. These new products became increasingly important in the face of rapidly transforming traditional markets. Soon after World War I, demand for the company's main product, the steam engine, declined heavily, as companies switched to electricity. To survive, Hardie-Tynes turned to the manufacture of dam and naval supplies; in 1932, the company supplied eighteen sluice gates for the New York City water supply system, as well as a number of slide gates for the Tennessee Valley Authority dam building program in the early 1940s. In addition, the company also became a regular supplier to the United States Navy. More recently, Hardie-Tynes secured

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[4] Foundry Magazine (Cleveland, OH., Penton Publishing, March 1901).

Advertisement in Silver Celebration (supplement of Birmingham Age Herald, Jan. 1913)

[5] Foundry Magazine (Cleveland, OH., Penton Publishing, 1900).

military contracts for components of the Tomahawk missile bases. These large contracts to some extent cushioned the company from economic swings. The 1970s proved to be a difficult time for the foundry trade - with the introduction of the Environmental Protection Agency and the Clean Air Act of 1970. Jefferson County (Birmingham) claims that no foundry closed due to these new regulations.[6] Yet, the regulations came at a time of recession and many foundrymen were pessimistic. "Air pollution requirements and the unavailability of good help should reduce the amount of castings produced. In short, we will be forced to cease operations," wrote one foundry representative.[7] Hardie-Tynes closed its foundry in the 1960s, turning it into a machine shop.

In addition to environmental concerns, competition from materials like steel and plastics and from imported foundry goods lead to the demise of over 500 American foundries from 1965-1975 and an additional 900 in the next decade, leaving a total of 3,403 foundries in the United States and Canada in 1991.[8] Traditional gray iron casting of Hardie-Tynes' type had been waning for years. Even more marked than the number of foundry closures was the drop in the number of cupolas in use. In 1965, 2,538 cupolas operated in the United States and Canada; by 1991 just 475--less than 20 percent of these cupolas--remained in operation.[9]

Hardie-Tynes Manufacturing Company traces its origins to Birmingham Iron Works, started in June 1882[10] by John Timons Hardie with $50,000 capital and 150 men.[11] Born in Alabama, Hardie moved to New Orleans in 1853 where he owned a successful cotton commission firm. Returning to Alabama,[12] he located in Birmingham where his son William Hardie trained in mechanical

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[6]Judy Hill, phone interview with author, 27 July, 1992.

[7]Foundry Magazine (Cleveland, OH., Penton Publishing, Jan. 1972).

[8]"Foundry Management & Technology, Metal Casting Industry", Metal Casting Industry and Census Guide, (Cleveland OH., Penton Publishing, Inc. 1992).

[9] "Foundry Management & Technology, Metal Casting Industry".

[10]Birmingham City Directory, (1887) p.270.

[11]Birmingham City Directory (1883-84).

[12]Armes, Ethel. The Story of Coal and Iron in Alabama (Birmingham, AL; Birmingham Chamber of Commerce, 1910).

engineering at Edinburgh University and worked at Sloss furnaces in the engineering department. William later managed the Birmingham Iron Works, located next to Sloss operations along First Avenue between 25th and 27th Street.

An early manufacturer of iron pipe, the Birmingham Iron Works soon concentrated on manufacturing machinery. An 1886 advertisement listed its products as: steam pumps, Corliss engines, slide valve engines, cast iron, gas and water pipes, plus casting and machinery of all descriptions.[13] By 1895 William Hardie had become general manager of the Birmingham Engine Works located on the same site as the Birmingham Iron Works. In October of that year, following the death of his father, Hardie and William Tynes incorporated the Hardie-Tynes Foundry and Machine Shop. William Hardie's son recalled the Mr. Tynes "was to manage the sales and business part, while Hardie would handle the mechanical part". [14]

From the start, Hardie-Tynes was tightly linked to Birmingham's industrial community. Accounting records for the month of October, 1895, show purchases from the Sloss Furnaces Company, the Birmingham Rolling Mill Co., the Woodward Iron Co., and the Alabama Rolling Mill Co. The company acquired sand from the Alabama Sand and Supply Company, and coal from the Lenida Coal Co., Standard Coal Co., and Corona Coal company, among others. Pioneer Mining and Manufacturing Co., the Warrior Machine Works, Birmingham Nut and Bolt Works and the Birmingham Boiler Works also provided materials. Hardie-Tynes also used the Birmingham Railway and Electric Service Company. The Louisville & Nashville Railroad (L&N), whose tracks formed one of the plant's borders, supplied sand and coke and possibly acted as an agent for product supply and delivery.

That these suppliers became major purchasers of Hardie-Tynes products indicates the extent of linkages among Birmingham and southeastern industries. By 1930, Tennessee Coal & Iron had purchased at least nine Corliss Engines, eight slide valve engines, twelve mine hoists, three air compressors, and a gas compressor from Hardie-Tynes. One of Hardie-Tynes' first big jobs in its 1901 plant supplied a continuous haulage hoist worth $4850 and a six million gallon pumping engine - made up of two Corliss Engines valued at $15,000 to TCI's Pratt Mine No. 7. Hardie-Tynes, on the other hand, regularly purchased pig iron, water, and steel from TCI.

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[13] John Witherspoon-Dubose, The Mineral Wealth of Alabama (Birmingham, AL., N.T. Green & Co., 1886)

[14] Lillian Galt Martin, John Hardie of Thornhill and His Family.

A major fire on January 24, 1901 destroyed the plant and prompted a move to the present site at 800 28th Ave North.[15] Fires were a particular hazard in the foundry and machinery business, and Foundry magazine listed twelve others that year. The new site, roughly eight blocks from the original site, expanded the East Birmingham area and allowed the company to build a larger, more modern plant.[16] In 1903, the firm changed its name to Hardie-Tynes Manufacturing Company. By mid July 1904, the new shops were "in full blast".[17] Hardie-Tynes used timber for both the foundry and machine shop. Brick or steel would have had load-bearing and fire resistance advantages, but were more expensive. It took another major fire, in 1924, before the company constructed and installed a sprinkler system.

In designing the new plant, Hardie-Tynes improved operations in many respects. The new plant took into consideration the efficient transportation of raw materials and finished goods around the site, adding easy railway access and electrically driven overhead cranes. In addition, rail lines linked the plant to the main track, as at Hardie-Tynes original plant, as well as various parts of the plant to each other. In contrast to the Birmingham Iron Works site, the new site allowed plenty of room for expansion. At the new plant, Hardie-Tynes devoted specific areas within the foundry to specific jobs--including core making and bench mold making--and also retained a large area of flexible space for individual jobs. Just as in the original plant, large jobs were cast in molding pits. The new plant separated pattern storage from manufacturing, due to the fire risk involved. This was a departure from the original Hardie-Tynes plant, where the pattern shop was above the machine shop and operated off the steam engine on the first floor; presumably, pattern storage was located there too. The original plant used both electricity and steam; at the new plant, steam generated electricity and drove the east wing of the machine shop. The original installation of engines is unknown, but repeated modifications to the power plant suggest that power requirements expanded well beyond 1901 forecasts.

An early order book entitled "after the fire July 1901" confirms

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[15] The Foundry, (Cleveland, OH., Penton Publishing Inc. March 1901).
"The extensive plant of the Hardie-Tynes Foundry and Machine Company was razed to the ground....entailing a loss of about $75,000."

[16] From title page of Hardie-Tynes order book (July 1901).

[17] Ironage, (July 1904)

that Hardie-Tynes had already developed a strong product base with regular customers. The firm was eager to resume business, taking just six months to build and equip the new plant. Its first two orders (for delivery on July 1 and 6) were substantial. The first was a contract for $1475 to supply the Bacon Milling Company with a 14" x 20" heavy duty engine, plus shafting, boiler, fire bricks etc. The second was a $2000 contract to set up a power plant for the Rome Furniture and Lumber Company in Georgia. This time, Hardie-Tynes supplied a 16" x 36" Corliss Engine with 12' fly wheel weighing 1000 lbs.

The company manufactured steam engines for a range of industries including lumber, coal mining and cotton oil and brick making; electrical power generation became particularly important. In 1904 Hardie-Tynes supplied six such engines, to electric companies in Indianapolis, West Virginia, Virginia, and Mississippi, trading across the South and into the Mid-West. The breadth and size of its early markets is shown by total sales figures for different products. The company made sixty-three Corliss engines in 1902, the peak year for their production, shipping twenty four to Alabama companies, fourteen to neighboring Georgia, four to Tennessee, seven to Mississippi, eight to North Carolina, and one to South Carolina. The market also stretched to Texas, Kansas, Arkansas, and Indiana. In 1906, the company also supplied Corliss engines to firms in Pennsylvania and New York.

Corliss engines proved to be a consistently popular product in the early years of Hardie-Tynes. They reached a wide geographical market and were adapted to a variety of needs. While major purchasers included cotton oil manufacturers, lumber companies and furniture makers, Corliss engines also powered operations at mining companies (winding hoists), brick companies and chemical firms. The engines could be very powerful, such as the 1200 hp Cross-Compound engine built for the National Cement Company in Ragland, Alabama.[18] The highest volume orders were for the more modest 7 1/2" x 10" and 10" x 15" engines. By 1926, Hardie-Tynes had amassed nearly 6000 drawings for these sizes, and roughly 1000 drawings for the larger sizes.

Different Corliss engines, identified by their efficient rotating valves housed in a rectangular casing, suited different needs. Hardie-Tynes advised using Tangye Frame Engines at plants with

[18]Reported in an unknown local paper (10 October 1977), the reporter spoke to Hardie-Tynes employee R.L. Baum. The engine's date is reported as 1907, but order books did not confirm this. The National Cement Company in Ragland was later purchased by Louisiana Rice, operating one of the largest rice mills in America.

high horsepower needs (300 hp or more), high steam pressure (over 150 lbs) or with fluctuating loads. Absent these conditions, a Heavy Girder Frame Engine was recommended. Hardie-Tynes claimed that it "has long been known as the strongest engine of its type on the market and its very general and successful use throughout the southern states is evidence of the appreciation of steam users."[19] Imperial Frame Engines ran with a shorter stroke and faster speed, and were favored for generators of electric power and lighting. With its frame cast in one piece and supported on the foundation throughout its length, the engine kept vibration to a minimum, another favorable factor for connection with generators.[20]

Hardie-Tynes proposed the most suitable engine for each customer's varying power, periods of use, and boiler pressure needs. Although engines used interchangeable parts, castings were made specific to each model and each engine was individually adapted to the customer's needs.

Along with the Corliss engines Hardie-Tynes also marketed slide valve engines as one of its main products.[21] Peak production of slide valve engines came in 1907 when at least twenty-five were made. Of these, eight were sold in Alabama, five in Tennessee, three in Florida, and a couple in Michigan, Georgia, Mississippi, Oklahoma, and Arkansas. Hardie-Tynes produced an average of almost twenty slide valve engines a year between 1902 and 1907, mainly for neighboring southern states. Some markets extended beyond Birmingham's immediate neighbors to North and South Carolina, Virginia, Maryland and Washington D.C.; west to Louisiana, Illinois, Arkansas and Oklahoma; and as far north as Michigan. The market was also diverse, including a variety of manufacturing firms.

Slide valve engines were less efficient than Corliss engines, and were more appropriate where fuel costs were not a consideration, as in lumber yard usage. In 1914, the company produced only three slide valve engines, in comparison with forty Corliss Engines.

The company also specialized in hoisting engines and complete power plants. A 1912 advertising brochure for steam hoisting engines boasted "the location of our plant in the midst of one of

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[19]Hardie-Tynes advertising bulletins, (Jan. 1919 to Sept. 1921) numbers 101-105.

[20]Hardie-Tynes advertising bulletins. Numbers 101-105.

[21]Hardie-Tynes pocket notebook, 1908.

the greatest mining districts in the country, producing both coal and iron ore, enables us to keep in close touch with the advancement in mining practice".[22] Hardie-Tynes produced First Motion hoists for high speed hoisting and geared engines for slower speeds for use with single or double drums of a variety of sizes that could also supply electric motor power if required. Even more so than (the relatively standardized) Corliss engines, each mine hoist was adapted to, or designed to meet, the needs of the customer. Records show that twenty-two hoists were made from 1904 to 1914, of which six travelled beyond Alabama's borders to neighboring Tennessee. The mine hoist market was both modest and strictly local at this time.

The early market for compressor engines was also small. Hardie-Tynes first manufactured them in 1906, for Sloss Sheffield Steel Iron and Coal Co., Palos Coal and Coke Co., and itself. Hardie-Tynes made at least seven such engines from 1909 to 1913, mainly for Alabama companies, a modest beginning for what was to become an important product.

Specializing in the production of steam engines, mine hoists and air compressors, Hardie-Tynes also undertook many small jobs, such as providing screws or machinery platforms. In 1901 it made two fire door liners, 15" high by 18" wide, for the Bonham Mill and Elevator Company of Texas. One of 1045 orders in 1909 was for "one dog house as per skitch (sic)", another was to repair the First Methodist Church's organ.

Hardie-Tynes encountered difficulty penetrating markets long dominated by northern manufacturers. Massee and Felton Lumber Co. of Georgia used Boston architects for their new plant. "Our architects being Eastern people were somewhat prejudiced against buying an engine in the South of the size that we had to have, viz - 800 horse power, and advised us in the outset that they did not believe that there was an engine built in the South as large as that, that would give us the proper service....."[23]
Twenty-five years later, many buyers were still prejudiced

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[22]Hardie-Tynes Bulletin 107, "Steam Hoisting Engines - Geared Type", (July 1912)

[23]Letter dated 1 April 1909 from Massee & Felton Lumber Co. The firm noted in correspondence with Hardie-Tynes, "Hardie-Tynes specifications were the best in the bunch...All the officers of this Company being full blooded Southerners, we felt disposed, of course, to buy a Southern engine, other things being equal...the price was considerably cheaper...these three things influenced us to buy a Hardie-Tynes engine, and we have never had occasion to regret it."

against the South. Many cited the chemical make-up of locally manufactured pig iron. Hardie-Tynes' foundry superintendent wrote in 1935 "While every practical foundryman who uses Birmingham iron finds this phosphorus content to be an asset rather than a liability, still when salesmen endeavor to interest buyers in other territories, they often meet with a polite raising of the eyebrows".[24]

An icon of southern gentility, the firm did well in the personal, face-to-face business relations of the early 20th century. According to Philip Henry Hardie, Hardie-Tynes' employees were praised as very pleasant people to do business with, and the salesman Mr. Monaghan, "a very competent engineer himself,"[25] was also appreciated. Mr. Hardie was a respected member of the business and social community and, likewise, William D. Tynes' reputation was that of "a gentleman."[26]

World War I narrowed Hardie-Tynes' product line to the provision of machinery and goods for the military. Corliss engines still accounted for 50 percent of Hardie-Tynes' output, but production of other goods, once stable elements of the company's product line, declined. For the war, Hardie-Tynes manufactured steam engines for Victory ships, cast iron propellers, and 2" shells. The company entered war production only reluctantly. When William Tynes balked at making shells, Franklin Roosevelt informed him "its your civic duty".[27]

Prior to the war, expansions to the physical plant were minimal and included only the joining of an original south end open air foundry crane to a north one in 1912, and the installation in 1909 of a new 16" x 36" Corliss engine in the engine room. But increased war time production necessitated significant changes to the company's physical plant. The foundry area was expanded in 1916 by incorporating foundry crane extensions into the main body of the foundry and constructing a new core oven. An increase in production lead to an increase in the demand for more power, requiring the 16" x 36" Corliss in the engine room to be replaced

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[24]Pig Iron Rough Notes, Sloss-Sheffield Iron and Steel Advertising (Jan. 1934)

[25]Letter dated 1 April, 1909 from Massee & Felton Lumber Co.

[26]Lillian Galt Martin, John Hardie of Thornhill & His Family, quote from Philip Henry Hardie.

[27]Robert Stobert Jr., grandson of W.D. Tynes, interviewed by author.

by a 18" x 30" Imperial Corliss with air compressor plus the installation of a 14" x 24" Imperial engine, in 1917. Another boiler was added in 1919 to serve the engine room. The original tracks and inclined plane from the storage yard to the cupola charging floor were replaced in 1918 by yard tracks and a covered elevator. That same year, Hardie-Tynes built a new cupola with a 66" inside diameter. A blowing house equipped with a Roots No. 7 blower and Westinghouse engine replaced previous blowing arrangements. The charging platform, cupolas, a later additional Sturtevant blower, and the foundry, with its ovens and original cranes, all remain on site.

In the post-war years, Hardie-Tynes could no longer rely on its steam engine market. Sales of Corliss engines declined from an average of forty engines a year before the war to only five each in 1921 and 1922. International markets resumed importance as agents Dibert, Bancroft and Ross of New Orleans and the Birmingham Machine and Foundry Company (a supplier of cane crushers) helped develop sales abroad; indeed, eight of the eighteen Corliss engines Hardie-Tynes made in 1920 went to Cuba's sugar industry. By the late 1920s orders for new engines had all but disappeared, although repair orders trickled in. Slide valve engine sales suffered even more from the competition from electricity. Sales of mine hoists and low pressure compressors also declined. Air compressor engine building ceased until 1923.

As demand declined for its traditional products, Hardie-Tynes developed new markets. In 1922 the company pulled down the 1919 storage shed to the east of the machine shop to make room for tracks and turntables for a large locomotive repair job, unusual work for a company that had never really been directly involved in locomotive work.

In August 1924 Hardie-Tynes' machine shop burned down, and the company took this opportunity to modernize both the plant and the equipment. American Machinist reported Hardie-Tyne's "loss of about $750,000,"[28] a figure that presumably reflected loss of stock. The investment appraisal estimated the cost of replacing the new shop (without contents) at $53,000 and valued machinery at $234,000. On the same date the foundry building was valued at just $39,230".[29] The difference in value reflected not just the fact the shop was new, but that it was expensively built. The

[28]American Machinist. (New York: McGraw-Hill, 25 Sept., 1924) p.522.

[29]Investment appraisal, Manufacturer's Appraisal Company (1926).

new shop used rolled steel and riveted steel columns and girders, in contrast to the timber framing of the original 1901 shop and foundry. This had a number of advantages for Hardie-Tynes, in addition to better fire-resistance. Although it covered the same ground area, stronger joists allowed the shop greater height--8' taller where the side wings met the main frame and taller overall by 14'--and gave Hardie-Tynes greater freedom to employ larger machines and tools and to work on larger machine parts. In rebuilding, the company also improved electric lighting and replaced the 10 ton Cleveland crane with 15 ton and 25 ton P & H cranes.

Some machinery survived the fire, such as the main layout table (which has a welding mend from where the crane fell on it) and the Niles boring mill. But the 1926 investment appraisal valued machine tools just 10 percent below replacement costs, suggesting most of the nearly seventy machines were new. The value was a substantial $233,928.84, giving the machine shop 90 percent of the company's total machinery value. The new machines in the 1925 shop were faster than machines of earlier years. In 1923, alterations in the power plant (which survived the fire) increased engine speed from 125 rpm to 150 rpm, enabling the company to run machines 20 percent faster. Three years later, Hardie-Tynes built a 14" x 8" x 16" air compressor, still in use, housed in a brick building alongside the machine shop.

Twice-struck by fire, the company finally installed sprinkler systems throughout its plant (sometime after the 1926 appraisal and before 1930), and moved a water tower to the site. The large tower is the highest visible physical element of the plant and is a company landmark.

By 1932, Hardie-Tynes had diversified its product mix substantially, producing air and gas compressors, aftercoolers and receivers, both Corliss and marine steam engines, mine hoists, needle and butterfly valves, hydro-electric machinery, dredge pumps and castings and chemical process equipment such as evaporators, vacuum pans and ammonia stills. Advertisements touted "gray iron, semi-steel and steel castings... furnished in any required tonnage and in single pieces weighing up to 100,000 pounds. A force of engineers is maintained for cooperating with plan facilities in the production of special machines and machinery to meet any needed requirements".

Compressors were among the company's most important products. Southern railway expansion generated a noticeable growth in sales of air compressors, and the emerging air transport industry generated some sales of gas and helium compressors, often for use in dirigible air ships. Local companies such as TCI bought compressors from Hardie-Tynes, and the company also supplied air compressors to the Jordan and Martin Dams, constructed by the Alabama Power Company in 1927 and 1928. Military equipment became an important product line. In 1928, Hardie-Tynes supplied the US Navy with a large 960 hp air compressor--early evidence of peace time military supplies, are still vital to the company's survival. The US Navy ordered twelve high pressure compressors in 1933, and the company supplied sixteen to two separate shipbuilding companies for naval use. Hardie-Tynes compressors worked at Portsmouth, Mare Island, Boston and at the Pearl Harbor Naval Base.

The company also developed an expertise in constructing specialized water and dam equipment. Its first projects provided service and emergency gates for the Yakima Dam and operating machinery (possibly hydraulics) for Wilson Dam in 1924. By the 1950s, the company supplied Alabama Power Company's network of dams across the state. Other notable water projects included the manufacture of hydraulic jacks and a dipper dredge, among other equipment, for the Panama Canal, and sluice gates for New York City sewers in 1930.

As Hardie-Tynes gained more experience, and as projects became more ambitious, the size of dam and water equipment grew. The first needle valve, built in 1928 was a relatively modest 42"; in 1937 a firm in Southern California purchased valve(s) of 90". Likewise the first butterfly valve was 132," built in 1931, destination unknown; two years later, Hardie-Tynes made both 120" and 168" valves (the latter weighing 400,000 lbs) for the Boulder Dam (later Hoover Dam).[30] Hardie-Tynes also supplied 96" paradox gates and 84" needle valves for this project in 1933 and 1934. The company produced a wide range of valves - from 10,000 lb 30" x 24" valves at $5,700 to 220,000 lb 108" x 108" valves costing $75,000. It also made hydraulic machinery to operate gates and other dam equipment. In addition Hardie-Tynes also supplied slide gates, self closing roller (or paradox) gates, and complementary gate hoists and hydraulic machinery.[31]

New markets in dam and water equipment offset declines in traditional equipment areas. Hardie-Tynes sold over thirty mine hoists between 1924-30. A 1930s sales brochure claimed "the

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[30]Written Notes, Jim Powell, Senior Lead Man (1928-1976), 7 July 1992

[31]Rily Raum, draftsman (1928-1976), interviewed by author, July 1992.

Ex-employees recall they made all the hydraulics for the Boulder Dam.

manufacture of high grade mine hoists has been a specialty of this company for forty years." By the late 1930s, though, this was a product line in decline. Some of the last hoists Hardie-Tynes produced were destined for the deep coal mines of England, France, Russia and South Africa. Hardie-Tynes claimed its 6 meter hoists to be the largest designed and built in the United States, weighing five hundred tons each with shafts that took both machine shop cranes to lift. One hoist worked at Barnbugh Pit, Yorkshire, England, where the winding engineman called it a "magnificent" engine, sometimes pulling millions of tons of coal per year. The engine was reportedly purchased by British Coal for only 10,000 pounds sterling, and worked from 1950 to 1982.[32]

The company also made at least eleven cotton compresses in the 1930s, five of them for the Federal Compress and Warehouse Company. These were not designed in house, and sales proved difficult. Hardie-Tynes also ventured into other cotton related machinery, such as 'twisters', but never fully developed this market. In addition, repair work continued to be an important part of the business, and could be high priority. For example, if a sugar mill's Corliss engine needed repair during cane harvesting, the 'breakdown job' was rushed and employees were paid overtime.[33]

The expansion of naval and dam equipment orders soon filled existing fabrication space. New tools gradually encroached into the north end assembly space, welding operations expanded, and assembly and machining operations competed for use of the two overhead cranes. To resolve these space problems, Hardie-Tynes erected an assembly shop in 1938, linking it by rail to the machine shop. Its steel columns supported a twenty-five ton P & H crane and a thirty ton Nile crane. Although some small assembly work continued at the north end of the machine shop (especially jobs requiring welding work), big shop tools gradually expanded into this area. The Betts boring mill (with a 20' swing) was installed about 1945, followed by the Putman lathe (48' between centers) and Carlton Drill Press (with a 10' arm).

Apart from the encroachment into former assembly space, Hardie-Tynes retained its longstanding machine shop layout even after the switch to electricity in 1945 potentially freed up shop space. Small lathes, for example, are still grouped near the south door. As there was no incentive to speed production via floor layout (as typified by car factory production), it remained more convenient to move the part to the tool. This was the case

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[32]R. A. Goodright, letter to Hardie-Tynes, 9 February 1989.

[33]Jim Powell, tour given of Hardie-Tynes, July 1992.

for larger tools whose foundations were too costly and time-consuming to move. New machinery tended to be bought when old machines were beyond repair, when new products required different tools, or when the size of the products grew, as in the 1945 installation of the Betts boring mill used to machine huge 6 meter diameter mine hoists.[34]

World War II brought significant changes to the plant. As a major ordnance supplier for the United States Navy, Hardie-Tynes provided high pressure compressors and turbine steam engines used extensively aboard Navy submarines, aircraft carriers and destroyers to power machinery and propel torpedoes. The steam turbine engines were noted for their use on Liberty ships. Naval products needed space for both assembly and testing. In 1940, Hardie-Tynes extended the assembly shop, and built test stands for both submarine compressors and 30' cubic compressors. The company also set up two assembly lines for the 20 and 30 cubic foot compressors, although the machine shop still was not organized on mass production lines. In addition, employees now worked ten hour shifts. In 1945 the power plant was changed to a power house. The steam engines stopped and instead the company bought its electricity from the mains, using transformers to convert to dc power where necessary (as with the overhead cranes).

Following the war, Hardie-Tynes struggled to survive as a small, independently owned company during a period of foundry closures and mergers. Vital to its success was the company's ability to continue its naval and dam related business. As in the past, the company had repair orders and encouraged older employees to stay on, or work part time, to help take advantage of their reservoir of knowledge and experience. The company also cultivated new business, such as a large project for insulating machines for Western Electric, and supplying equipment for big environmental engineering projects.

A company priority was to find a product to replace the role of high pressure air compressors in generating naval ordnance orders. In the 1950s, Hardie-Tynes developed steam turbine-powered forced draft blowers and turbo driven boiler feed pumps (adapting the machine shop and assembly shop in the mid 1960s) used on many United States Navy ships in the Korean War. Major navy vessels such as the John F. Kennedy, launched in 1968, utilized both Hardie-Tynes blowers and pumps.

The company also worked briefly on the reaction vessel for the Nautilus atomic submarine and on small high pressure compressors

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[34]Jim Powell, phone interview with author, 28 August 1992.

for scuba divers, for the Navy. Naval equipment and dam building programs continued to be important, especially deep water gates and, more recently, those for shallower water as well. In addition, Hardie-Tynes began making components for Tomahawk missile canisters developed by U.S. Naval Engineers.[35]

After the war, Hardie-Tynes closed the foundry and converted it to a fabrication shop. By then, it was outdated: little investment had been made since World War I, with the exception of an increase in air blast capacity in 1945. One former employee noted that the foundry 'was modern for its time..but it got to be very crude.'[36] After World War II, it was used primarily to melt iron for large flood gates, for repair jobs and for the cylinders of high pressure air compressors. The company turned increasingly to steel fabrications for their greater strength and other desirable properties, and used a wide range of alloys for special jobs. Hardie-Tynes cupolas were not suitable for melting steel and large scale investment would have been required to convert them. The company also had difficulty recruiting good foundrymen. Its pay and benefit package could not compete with other specialized foundries' pay and benefit packages, and the master molder's art was a dying trade. The foundry worked on and off for a long time, until it closed for good in 1962, well before the Environmental Protection Agency pollution regulations of the 1970s.[37]

In 1972 the company took the first tentative steps toward fabricating steel (i.e. cutting, bending and welding to produce the desired shape) in the south end of the foundry used at this time for storage and junk). In 1974, prompted by the closure of one of its major suppliers of fabricated steel,[38] Hardie-Tynes invested in a fabricating shop - giving the firm more control over its fabricated metals and a more competitive cost. Cranes that moved iron castings were used to move fabricated steel, the sand floor became concrete, and trucks drove into the south end of the fabrication shop over the railway tracks that once linked foundry and machine shop.

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[35]Mr. Gordon Flynn, President of Hardie-Tynes, interview with author, 29 July 1992.

[36]Rily Raum, interview with author, July 1992.

[37]Herman Taylor, ex-employee of Hardie-Tynes, interview with author, 13 August 1992.

[38]Robert Stobert Jr., interview with author, 30 July, 1992.

APPENDIX

Making the Mine Hoist Drum
Introduction

The following information explains the production of a specific piece of machinery, the drum of a large mine hoist, at Hardie-Tynes in 1925. This text accompanies the Historic American Engineering Record drawings that recreate the process using Hardie-Tynes engineering drawings, period text books, oral histories and by studying the largely intact Hardie Tynes plant, especially the pattern shop, patterns, and the foundry with its ovens, cupolas and charging floor.

The hoist illustrates the way Hardie-Tynes cast large, intricate pieces of machinery on the foundry floor. Many Hardie-Tynes castings, some even larger, would have been made in a similar fashion. In 1919, there were three circular casting pits 6' deep and 15'-16' in diameter, and two rectangular pits (one marked as an 'iron flask') 9' x 7' and 8' x 33' in dimension. Molds for smaller castings were made either of dry sand (baked to dry out the sand) or green sand (with no drying). Smaller molding probably occurred in the wing opposite the cupolas, where molding machines are shown in 1912 drawings. In addition, the foundry contained a number of machines to aid the casting process. Hardie-Tynes made its own tumbler and grinder for cleaning castings, used a Munford Rammer in mold making, and for sand preparation used two Blystone core and sand mixers and a couple of Western riddles.[39]

Insurance records give some idea of the scale of Hardie-Tynes operations. They also emphasize the point that, though Hardie-Tynes specialized in a few products such as mine hoists or Corliss steam engines, these were frequently adapted to the needs of each customer, requiring new drawings and patterns for use in the foundry. By 1926, Hardie-Tynes had over 15,000 patterns and core boxes, of which only 2,500 were considered obsolete (but still usable). This stock was valued at over $500,000; the stock of foundry flasks and riggings was worth more than double that figure.[40]

Visitors to Ruffner Mountain Nature Center in the city of Birmingham enjoy remnants of an industrial landscape. The remains of ore mines once belonging to Sloss Sheffield Steel and

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[39]Investment appraisal, The Manufacture's Appraisal Company, 1926.

[40]Investment appraisal, 1926.

Iron are evident, but nature has reclaimed much of the land. Among the remnants of the former complex is Mine No. Two, worked on adjacent land until 1953. At the mine opening, which is still visible, is a concrete foundation that served as a base supporting an 800 hp electric mine hoist made by Hardie-Tynes for the Montevallo Coal Mining Company in 1925.[41] The hoist was quite large: its powerful drum measured 7' in diameter and turned once every second at 68 rpm, pulling the steel rope that entered deep into the mine an average speed of 1600' per minute. It could carry a load of up to 22,000 lbs of ore and miners.

The mine hoist reflects the integrated nature of iron production in the Birmingham District. The Sloss Co., which owned Ruffner, was a major producer of pig iron for the district. Made with local iron ore, coke and limestone, pig iron was sold to local as well as national and international foundries. Hardie-Tynes was one such foundry, supplying eleven mine hoists to Alabama iron ore sites. The inter-related nature of iron production in the Birmingham district, in large part arising from its rich raw material reserves at close proximity and its good transportation networks, was vital to Birmingham's success as a major iron center. In the Birmingham area, these factors helped to create a new industrial district based on foundry iron.[42]

Stage One: The Drafting Office

Once the order for the 800 hp hoist was received, the drafting office (at that time a large open room in the west wing of the second floor of the office block) put together a complete set of plans. The chief engineer for this job was probably A.G. Reese, originally from Ohio, who was brought into the company for his particular skills in the field of hoist manufacture.[43] The complete set of drawings, first made on brown paper and then traced onto cloth, included both new drawings and reproductions of former designs. For example, the main drum was designed by re-using drawing 42-158, an 800 hp drum made earlier that same year for the Alabama By-Product Co. (ABC) of Birmingham, Alabama. However this particular drum was longer (from flange to flange) than the Montevallo Coal Mining Company's requirements, so the pattern makers may have reused parts of the old patterns and

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[41]Bob Yuill, interview with author, August 1992.

[42]In Ironbridge, England, where iron was first smelted using coke (not charcoal) in the eighteenth century, the abundance of raw materials close by and good transportation system helped earn it the label 'the birthplace of the Industrial Revolution'.

[43]Rily Raum, draftsman, interview with author, 1992.

crafted new main cylinder sections adapting the ABC hoist drawings.

Conditions for the draftsmen were primitive by today's standards. Lacking air-conditioning, the draftsmen kept their arms covered to prevent sweat from dripping on their drawings. There was no blueprint machine but, rather, a device that "slid out of the winder, and made a print by the sun". The dirty foundry also posed problems: "when you went to lunch you had to cover your desk up or you'd get half a ton of soot on it."[44]

Stage Two: The Pattern Shop

After leaving the drafting room, a set of drawings went to the upper floor of the pattern shop, where existing patterns were taken from storage and new ones made by skilled pattern makers. The pattern shop is a two story building, with carpentry tools on the upper floor, space for lumber storage, and racks for pattern storage. Patterns were also stored in a couple of other areas on site. The patterns were used to make molds and cores for the foundry, and were mostly of white pine, painted with wood preservative, and stamped with a unique reference number. The pattern shop operated an index system for its storage of patterns. Rily Raum recalls pattern storage as haphazard: workers just "dumped it (sic) in there", and "half of my job was to try and find the pattern when you got a repair job." They were then carried to the foundry. His job was further complicated by the rats that occupied the storage area, thus he would carry a big stick.

Stage Three: Core Making

The hoist drum was cast in one piece, rather than with flanges cast separately and then bolted on--a common foundry practice. Casting in one piece increased the strength of the mold. Without the actual core boxes, it is impossible to be sure exactly how this hoist was made, but one reasonable assumption is that the hoist drum was cast vertically in two flasks. Former employees recall the use of vertical casting in the foundry.

Assuming the vertical cast method, the two cast-iron flasks were filled with sand, with an internal cavity created by patterns. Cores, shapes made out of baked sand, were placed in the center of the mold cavity to create the drum's ribs and hubs. The shape of the wooden core box made by the pattern makers was thus determined by the shape of the cavity to remain in the casting. The cores for the hoist could have been made in a number of

[44]Rily Raum, draftsman, interview with author, 1992.

shapes--like layers of a cake--or in segments.

The core box was packed with clean silica or quartz sand with good refractory qualities to withstand the heat of the metal and permit the escape of gases. The sand was mixed with a binder to provide both 'green bond', so it held its shape while damp, and 'dry strength', so the cores could be handled after drying. Suitable binders might be linseed oil or, for a large core, a cereal binder, pitch binder, glutrin or dextrine; water and molasses was also commonly used.[45]

The sand mixture was rammed into the core box. Large cores such as those for the mine hoist drum would use coke, nails or pieces of scrap to improve venting.[46] Small venting holes were made by running a wire through the core. Standard foundry practice suggests that,

> Wherever possible, core boxes should be made with their widest opening exposed for ramming the core, and designed so that the core may rest, while being baked, on the flat surface formed by striking off at this opening....molasses water or glutrin water is usually sprayed on large cores, except those made from linseed oil binders. This gives the core a hard surface. Linseed cores have a hard surface due to the oxidation when drying.[47]

Stage Four: Core Baking

By 1916, Hardie-Tynes had constructed a large core oven at the west end of the main foundry and was likely using the larger of the two 1901 ovens both as an annealing oven, as shown on the 1911 map, and for core baking. These core ovens were heated by fires stoked manually in brick boxes on the outside of the foundry. Core making probably occurred in the foundry bays alongside these ovens.

Cores were placed on trolleys linked by chains to overhead cranes that moved them in and out of the ovens. Cores were baked (not dried) to a mahogany brown color. It was common practice before or after baking the core to face it with blacking, as with the mold.

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[45]W. C. Stimpson and B. L. Gray, Foundry Work (American Technical Society, 1940)

[46]Information from author's tour of plant, 7 July 1992.

[47]Information from author's tour of plant, 7 July 1992.

Stage Five: Making the Mold

A casting the size of a hoist drum would have been made near the cupolas to avoid transporting the iron over a long distance. The bottom flask (the drag) likely was made on the foundry floor, allowing foundrymen to prepare a layer of coke or crushed brick below the level of the sand floor to help with escaping gases from the cooling metal.

The Drag: The bottom half of the pattern was placed in the center of this cylindrical vessel, with sprue-sticks (wooden dowels) between the pattern and flask wall. Facing sand was sifted to a depth of one inch and packed by hand next to the pattern. This was usually good quality silica mixed with sea coal to prevent the hot metal from fusing the sand to the casting. However, for skin-dried molding (molds dried by direct application of heat), a binding material such as wheat flour could be used.[48]

Sand was packed gently at first with the top end of a ram. Areas away from the pattern were packed with the ram's butt end and trodden down, sometimes by air rammers. Sand could not be packed too tightly or gases could not escape; but packed too loosely, the pattern shape would not hold up. Vent wires also aided the escape of gases, and were linked to holes in the flask walls. The sand was then struck off level with the top of the drag. The cylinder part of the pattern was lifted out first, followed by the flange. The drag was then ready for facing with a heavy coat of wet 'blacking' made of ground sea coal mixed with water and possibly some molasses. For a large mold this could be rubbed on by hand.

The Cope: The cope or flask containing the top half of the mold, was made in a similar fashion. The other half of the pattern was placed in it, and again sand was packed around. This flask was inverted, so it had cross bars to help support the weight of the sand during handling. Molders often included L-shaped pieces of metal called "gaggers" that linked over cross-bars in the flask and reinforced and helped lift the weight of the sand. Foundryman also created the gates, sprues and risers--the means by which the molten metal flowed into the casting cavity. Before assembly both flasks were 'skin dried' to increase the strength of the mold, by being lowered in a bucket of hot coals.

Assembling the Mold: The assembly of flasks and setting of cores were parts of the founder's art. It could take "days and days to

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[48] R. E. Wendt, Foundry Work (New York: McGraw-Hill Book Co., Inc., 1942)

set them just right,"[49] though a full working shift was perhaps a more normal time span. During the operation (which may have taken three days for a mine hoist) the molder worked closely with the patternmaker in making and setting the mold and cores, assisted by a group of journeymen and helpers. The cores were supported on metal chaplets, and the cope placed on top of the drag. The two halves of the mold were clamped securely together and weighted down to prevent the liquid metal from forcing the mold apart.

Stage Six: Making Molten Iron

Both cupola furnaces present at Hardie-Tynes in 1925 remain. The larger 66" cupola, built by Hardie-Tynes in 1918, has twelve tuyeres (where blast air entered the cupola) below an air box that equalized the blast, plus openings into the tuyeres for both cleaning and viewing inside the cupola. The smaller, 44" Newton cupola dates to 1901. Its tuyeres are combined with its air box, and it has separate peep holes. The blower could feed both cupolas, but it is more likely that the blast was directed to one or the other of the cupolas at the "Y" junction in the blast mains.

Preparing the cupola for melting, workmen repaired its lining from the previous firing by chipping off remaining slag and daubing the lining with a coating of fire clay and sand mixture. The bottom door was propped shut and all the joints rubbed with fire clay before a layer of sand (possibly "gangway" or old molding-sand) was put in to make the sand bed. Next, small pieces of wood, shavings, and other combustibles were lit at the bottom of the cupola and coke charged above. Coke depth was important: if the bed was too high, too much fuel was used; if the bed was too low, the tuyeres (where blast air entered the cupola) would blow air unheated by coke into the iron mix, leading to cooler iron and possible oxidation. The tapping spout for the molten iron was packed with fireclay over small pieces of coke, to give a solid surface to push against.

For the mine hoist drum, foundrymen filled the mold with "semi-steel" rather than simple gray cast iron. "Semi-steel" consisted of fifteen percent to twenty-five percent steel, yielding iron of lower carbon content and greater strength.[50] The same result could have been achieved by burning out carbon from the pig iron, but would have required more heat and more costly coke. For a 'semi-steel' casting, pieces of steel would be charged directly

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[49]Jim Powell, tour of plant, 7 July 1992.

[50]E. Kirk <u>Foundry Irons</u> (Henry Carey Bairds & Co., 1911)

above the bed of coke (where the cupola was hottest) followed by layers of coke, limestone, coke, pig (blast furnace) iron, coke and scrap iron.[51]

A company bulletin advertised that for Corliss engines "great care is exercised to insure the use of the material best suited for each of the many parts which go to make up the engine: and special irons selected by chemical and physical tests are used in the several mixtures required to produce the best castings for cylinder, frame and wheel".[52] Sloss furnaces' Pig Iron Rough Notes confirm that care was taken to furnish foundries with the exact mixes of iron they required, confirming that the hoist's metallurgy was carefully considered and controlled.

In 1918, Hardie-Tynes erected an elevator to carry charging trucks from the storage bins and yard up to the charging floor, where they were manually emptied into the cupola. The charging floor sloped down slightly toward the cupolas, aiding the movement of the laden trucks (a couple of the trucks, a simple trolley and one with a top-hinged side door, plus turntables and tracks in the charging floor, survive).

After the charge had been heated for at least one hour (and possibly up to two-and-a-half), blast was applied. The blowing engine in the adjacent blowing house forced air into the coke via the cupola tuyeres, causing temperatures in the cupola to rise markedly. Within 8 to 10 minutes, the steel and iron liquified and the plug at the base of the furnace was rammed open by a rod, allowing the molten metal to flow out along the spout into a preheated fire clay lined ladle supported by the overhead crane. In 1926, Hardie-Tynes had seven crane ladles, the largest carrying 26,000 lbs. Slag was run off via a slightly higher spout into the cupola room. The cupolas could be charged continuously until sufficient molten iron had been collected. The bottom of the cupola was then dropped, allowing remaining coke, slag and unmelted iron (the "bear") to fall to the ground where it was water cooled. The cupola lining then cooled quickly, enjoying a longer life.

Stage Seven: Making the Casting

The overhead crane delivered the ladle of iron to the waiting mold, where it was manually tilted into the pouring boxes. A casting the size of the hoist needed more than one pouring box

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[51] R. E. Wendt Foundry Work (New York: Mc Graw-Hill Book Co, Inc., 1942)

[52] Hardie-Tynes Bulletin 101, April 1921.

and more than one ladle of iron.

The arrangement of the interconnected gates and sprues ensured the quick distribution of molten metal throughout the mold. The pouring boxes on top of the cope, (or pouring basins molded into the cope), were linked via sprues through the sand in both flasks to the gate, where molten metal entered the casting cavity. Sprues were also linked to the spokes of the bottom spider and the drum's hub and flange.

As the casting cooled, its metal shrank and it was necessary to top the supply of metal via the risers or feeders.[53] To keep the metal fluid, heated rods were pushed through the riser, into the casting, and churned as more metal was added. The rod was gradually withdrawn as the metal solidified.

Stage Eight: Cleaning the Casting

The iron then cooled, possibly up to twenty-four hours in the case of large castings such as the hoist drum. When released, the sand was dug away with shovels until the casting could be lifted out by an overhead crane. The cores disintegrated with the heat of the casting and the sand fell out.

The drum casting was transported to the south end of the foundry for cleaning by sand blasting and removal of fins left by gates and feeders.[54] Much of the work done by machine in larger foundries and foundries concentrating on a small, frequently repeated product range, was done by hand at Hardie-Tynes.

Stage Nine: Annealing the Casting

Once cleaned, the drum casting was annealed at 1200'F to 1400'F twelve hours before cooling gradually.[55] Annealing relieved internal stresses, reduced the tendency to fracture, and improved machinability of the casting.

Machining and Assembling a Mine Hoist

Once cast, the mine hoist parts (drum, brake, bearing blocks etc..) for the Montevallo mine hoist were moved from the foundry

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[53]R.E. Wendt <u>Foundry Work</u> (New York: McGraw Hill Book Co., Inc., 1942).

[54]Rily Raum, draftsman (employed at Hardie-Tynes 1928-1976), interview with author, 1992.

[55]Edwin W. Doe <u>Foundry Work</u> (New York: Wiley, 1951).

to the machine shop by a twelve ton, eight wheeled, steam powered locomotive crane. For machining purposes, the casting was made slightly larger than the finished product required.

The flow of materials through the shop influenced machine shop arrangement. Machines were grouped by type (for example, lathes in the southeast corner), by use (as with the grinders, lathes, drills and mills used to make and sharpen cutting tools in the tool room), or to suit the power drive.

Until the mid 1940s (when Hardie-Tynes ceased to generate its own power), machines on the east side of the shop were driven directly by the large (18" x 30") Corliss engine in the adjacent engine room, with the belt drive running roughly three quarters of the length of the shop. Those on the west were also belt driven, but were powered by electricity generated by a smaller (12" x 24") Corliss engine. Larger machines, driven by electric motors, were generally toward the north end of the shop, beyond the reach of the belt drive shafting. Assembly took place in the north end of the shop. The shop contained approximately seventy machines, including eighteen lathes, the most basic and versatile machines. Which machine was used for which job was largely a question of size.

A variety of cranes and hoists moved materials around the shop. Two overhead P & H cranes (one ten-ton and one twenty-five-ton) moved machine parts (and machine tools when necessary). In addition, work was transferred by two jib cranes, a two-ton Yale and Towne four wheel traveller riding 64' 6" of overhead hoist track, two two-ton and two one-and-one-half-ton Yale and Towne differential chain hoists, a two-ton Yale and Town Triplex chain hoist, and a Franklin (size C) portable crane and hoist.

Machining the Mine Hoist Drum

The drum was first taken to the layout table where Tom Powell and Henry Morgan, layout man and checker, compared it to the engineers' drawing for things as the thickness of the casting. It was then marked with 'set up' lines showing where the drum should be machined on the boring mill. The hoist (7' diameter) would have required machining on the Cincinnati 10' x 16' mill, located alongside the machine shop office and tool room. Large machines such as this were run by an operator and a helper; until the 1960s, the operator was usually white and the helper black, although the helper might have been a white apprentice. Hardie-Tynes took on its last apprentice in the mid 1930s.[56]

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[56]Herman Taylor, interview with author, 13 August 1992.

The drum was clamped into position, excess stock bored away, and the casting inspected to make sure it was sound (no holes or cracks). At the first stage, the drum's hub was bored to the bottom, the end meeting the brake band finished, and the sides of the drum machined. Next, the drum was turned over, clamped down on parallel blocks to make it even, and the other end finished. At this point, it would be tested with a dial indicator to make sure it was a perfect cylinder.

The drum was returned to the layout table to be marked for drilling, tapping, the cutting of keyways, and the starting location for the rope grooves on the drum. After drilling, the keyway was planed on one of two planers. The drum was held steady with a bar through its bore, and the keyway was cut into both hubs in one operation to make sure it lined up exactly. Rope grooves were cut on the boring mill. The drum was then taken to the back end of the shop for assembly.

Making the Mine Hoist Shaft and Key

The 15' steel shaft was forged in the blacksmith shop under either an 1100 lb or 3500 lb steam-driven Bement Miles hammer. A 100 lb motor driven "Little Giant" Mayer hammer worked smaller steels. Both open hearth furnaces and the furnace used to reheat steel for forging were blown (via underground piping) by the Sturtevant blower still adjacent to the engine room.

Foundrymen checked their work by calipers and by eye. The skill demonstrated in both calculating the amount of steel needed and in making and forging the correct shape (in the case of the hoist shaft in making it straight) was much admired by fellow employees.

From the smith shop the (slightly oversize) shaft went to a large lathe for turning until it matched drawing dimensions. The shaft varied in diameter from 12" at the bearings to 13" at the gear end of the drum. The keyway was marked out at the layout table, probably in the form of two circles connected by a straight line. Measuring 2 5/8" wide by 7/8" deep, it was cut first on the drill press and then the planer.

The key was forged of steel and machine finished on a shaper. The shaper was probably the 20" Gould and Eberhardt "miller".[57] The key ends were marked to match the circular ends of the keyway on the layout table, and the key then ground and filed to shape. Hardie-Tynes had a dozen grinders, most for keeping tools sharp,

[57]Rily Raum, draftsman, employed by Hardie-Tynes 1928-76, interview with author, 1992.

and two listed in the 1926 investment appraisal as 6" Norton lathe grinders.[58]

Finishing the Mine Hoist Frame and Bearings

Joints and other surfaces contacting machine parts were planed and bolt holes drilled. It is likely the bearing housing was worked out by hand before being lined with babbitt. The drawings show grooves in the bearings to hold in the molten babbitt. When the bearing caps were finished they were bolted on (the basic bolt holes had been cored at the foundry) and taken to the Bement-Miles large boring bar/mill to bore the length of the shaft.

Assembly

Other parts for the hoist, such as the brake, gear casing and platform, were also cast and machine finished. The hoist was assembled in the north end of the shop, possibly under the supervision of Mr. E. P. Baum, another employee dating back to the early days of the company who both assembled machines in the shop and on site.

Suggestions For Further Research

Hardie-Tynes has a wealth of documentary evidence. For example, comparison of investment appraisals over time will help understand changes in the machine shop. Likewise, further analysis of the complete accounts records would give better understanding of regular suppliers and the changing nature of costing factors. Board Minutes also survive and could prove useful.

Additional research identifying Hardie-Tynes' Birmingham context would also be useful. The relationship between the Birmingham iron furnaces and foundries needs to be explored. The Sloss Sheffield Steel and Iron's Pig Iron Rough Notes provide excellent documentation.

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[58]Machines 66 and 67, investment appraisal, 1926.

WORKS CITED

American Machinist. New York: McGraw-Hill, 1877-1960.

Armes, Ethel. The Story of Coal and Iron in Alabama. Birmingham, AL.; Birmingham Chamber of Commerce, 1910; reprint, Leeds, AL: Beechwood Books, 1987.

Birmingham City Directory, 1883-84, 1887.

"Foundry Management and Technology, Metal Casting Industry", Metal Casting Industry and Census Guide. Cleveland Ohio: Penton Publishing, Inc., 1992.

Foundry. Cleveland OH: Penton Publishing Co., 1892-1974.

Ironage. July 1904.

Kirk, E. Foundry Irons. Henry Carey Bairdst Co., 1911.

Lewis, David W. Sloss Furnace. Tuscaloosa & London: University of Alabama Press, 1994.

Martin, Lillian Galt. John Hardie of Thornhill and His Family.

Moldenke, E. M., The Principles of Iron Founding. London: Hill Publishing Co., 1917.

Simpson, Bruce Liston. History of the Metalcasting Industry. Des Plaines, IL: American Foundrymen's Society, 1912.

Stimpson, W. C. & Gray, B. L. Foundrywork. New York: American Technical Society, 1940.

Turner, W. P. Machine Tool Work. New York: McGraw-Hill, 1932.

Wendt, R. E. Foundry Work. New York: McGraw-Hill, 1942.

White, Marjorie L. The Birmingham District, An Industrial History and Guide. Birmingham, AL: The Junior League of Birmingham Publishers, 1981.

Witherspoon-Dubose, John. The Mineral Wealth of Alabama. Birmingham, AL.: N.T. Green & Co., 1886.

ADDENDUM TO
HARDIE-TYNES MANUFACTURING COMPANY
Birmingham Industrial District
800 Twenty-eight Street North
Birmingham
Jefferson County
Alabama

HAER No. AL-13

HAER
ALA
37-BIRM,
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BLACK AND WHITE PHOTOGRAPHS

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